Probablistic Analyses of Waste Package Quantities Impacted by Potential Igneous Disruption at Yucca Mountain

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A probabilistic analysis was conducted to estimate ranges for the numbers of waste packages that could be damaged in a potential future igneous event through a repository at Yucca Mountain. The analyses include disruption from an intrusive igneous event and from an extrusive volcanic event. This analysis supports the evaluation of the potential consequences of future igneous activity as part of the total system performance assessment for the license application for the Yucca Mountain Project (YMP). The first scenario, igneous intrusion, investigated the case where one or more igneous dikes intersect the repository. A swarm of dikes was characterized by distributions of length, width, azimuth, and number of dikes and the spacings between them. Through the use in part of a latin hypercube simulator and a modified video game engine, mathematical relationships were built between those parameters and the number of waste packages hit. Corresponding cumulative distribution function curves (CDFs) for the number of waste packages hit under several different scenarios were calculated. Variations in dike thickness ranges, as well as in repository magma bulkhead positions were examined through sensitivity studies. It was assumed that all waste packages in an emplacement drift would be impacted if that drift were intersected by a dike. Over 10,000 individual simulations were performed. Based on these calculations, out of a total of over 11,000 planned waste packages distributed over an area of approximately 5.5 km^2 , the median number of waste packages impacted was roughly 1/10 of the total. Individual cases ranged from 0 waste packages to the entire inventory being impacted. The igneous intrusion analysis involved an explicit characterization of dike—drift intersections, built upon various distributions that reflect the uncertainties associated with the inputs. The second igneous scenario, volcanic eruption (eruptive conduits), considered the effects of conduits formed in association with a volcanic eruption through the repository. Mathematical relations were built between the resulting conduit areas and the fraction of the repository area occupied by waste packages. This relation was used in conjunction with a joint distribution incorporating variability in eruptive conduit diameters and in the number of eruptive conduits that could intersect the repository.